

NORTH ATLANTIC TREATY ORGANIZATION



RESEARCH AND TECHNOLOGY ORGANIZATION

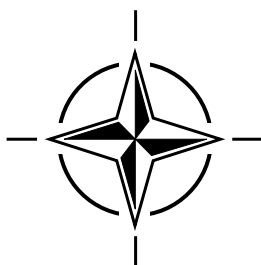
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RTO MEETING PROCEEDINGS 33

# Operational Issues of Aging Crewmembers

(les Conséquences opérationnelles du vieillissement des équipages)

*Papers presented at the RTO Human Factors and Medicine Panel (HFM) Symposium, held in Toulon, France, 11-14 October 1999.*



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- SCI Systems Concepts and Integration
- SET Sensors and Electronics Technology
- IST Information Systems Technology
- AVT Applied Vehicle Technology
- HFM Human Factors and Medicine
- MSG Modelling and Simulation

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# **Operational Issues of Aging Crewmembers**

## **(RTO MP-33)**

### **Executive Summary**

The Human Factors and Medicine (HFM) Panel held a Symposium on “Operational Issues of Aging Crewmembers” in Toulon, France, from 11 to 14 October 1999.

In many NATO countries, the populations in general are aging and military crewmembers are an increasingly older population. In downsizing militaries with scarce resources, the increasing costs of training and the significant experience (also at significant cost) of aging crewmembers make them an increasingly valued commodity, particularly as projected in the militaries of the future. Experience, wisdom, healthy lifestyles, and medical and technological advances seem to compensate to some extent for decreased performance and other adverse effects of aging (physical, physiological and psychological) in many crewmembers. Most “aging” studies have accumulated data on general civilian populations and data on the performance of aging crewmembers in military environments have not been previously summarized and presented on any large scale. Thus, the NATO HFM Symposium on “Operational Issues of Aging Crewmembers” was planned to present available data regarding whether or not healthy lifestyles, technological advances and compensatory factors of aging crewmembers, such as experience, adequately compensate for performance among various types of aging crewmembers (pilots, special crew, divers, etc.). If so, a re-evaluation of age policies for military crewmembers might be justified.

The Symposium was divided into 3 sessions to accommodate the various topics related to aging crewmembers working in various stressful military environments. In the Session “Operational Aspects of Aging Crewmembers”, papers were presented on G tolerance, jet lag, spinal disease, ECG findings during centrifuge training, hypoxia tolerance and time of useful consciousness during hypobaric flights, and pulmonary function in divers. In the Session on “Aging Crewmembers: Psychological and Cognitive Performance Implications”, there were presentations on sleep, working memory, personality, behavior, fatigue, risk taking, safety and mission completion, psychological performance, cognitive and sensory limitations and neuropsychiatric referrals. During the final Session, on “Physiological and Sensory Aspects of Aging”, papers were presented on anthrax immunization, growth hormone, endocrine responses to training programs, autonomic cardiovascular control, biochemical-metabolic indices, endothelial dysfunction, intima media thickness, cardiovascular risk factors, visual acuity, ocular problems, intraocular lenses, visual performance during small letter contrast tests and on modern cockpits.

While much of the available data on the effects of aging on human performance has been acquired from general populations, this Symposium provided data on the effects of aging on performance in crewmembers, not usually considered ‘elderly’, who live and work in stressful military operational environments (such as hypobaric, hyperbaric, high G forces, etc.), and frequently do so for prolonged periods. This data is particularly militarily relevant considering the increasing average age of populations (including military populations); the projected increasing costs of training and reduced resources and manpower in many militaries; and, therefore, the ever increasing value of healthy, experienced, aging crewmembers.

Significant conclusions that can be drawn from the data presented were three. (1) During these times of prevention, health promotion and healthy lifestyles, physiologic age of individuals seems to be more important than chronological age of groups. (2) Knowledge, behavior and experience seem to adequately compensate for aging among crewmembers in military environments. (3) The aforementioned, combined with new medical and surgical therapies and technological advances (in equipment designs, etc.), appear to justify seriously re-looking at current age policies for military crewmembers (particularly if, and when, a country’s military manpower and budget projections deem it appropriate).

# les Conséquences opérationnelles du vieillissement des équipages

(RTO MP-33)

## Synthèse

La commission des facteurs humains et médecine (HFM), a organisé un symposium sur «Les conséquences opérationnelles du vieillissement des équipages» à Toulon, en France, du 11 au 14 octobre 1999.

De manière générale, les populations de bon nombre de pays de l'OTAN sont vieillissantes et l'âge moyen des équipages militaires est de plus en plus élevé. Dans une situation où il est nécessaire de réduire le personnel militaire à moindre coût, et où les coûts de formation ne cessent d'augmenter, l'expérience déjà acquise par les équipages vieillissants (dont le coût a également été considérable) fait que ce personnel est de plus en plus prisé, et est donc souvent pris en compte dans les prévisions des forces armées pour les années à venir. En effet, l'expérience, le bon sens, les habitudes saines de vie quotidienne et les progrès technologiques et médicaux semblent compenser dans une certaine mesure la diminution des performances et autres effets négatifs du vieillissement (physiques, physiologiques et psychologiques) pour la plupart des membres des équipages. Jusqu'à présent, la plupart des «études sur le vieillissement» ont porté sur des populations civiles, et les éventuelles données sur les performances des équipages vieillissants dans des environnements militaires n'ont jamais été synthétisées ni présentées de façon complète. Par conséquent, le symposium NATO HFM sur «Les conséquences opérationnelles du vieillissement des équipages» a été organisé dans le but de présenter les données disponibles sur cette question. Il s'agit de déterminer si les styles de vie équilibrés, les progrès technologiques et un certain nombre de facteurs de compensation chez les équipages vieillissants, tels que l'expérience, compensent de façon adéquate ou non la diminution des performances des différentes catégories de personnels navigants (pilotes, membres d'équipages, plongeurs etc..) Si tel est le cas, une réévaluation des politiques en matière d'âge pour les membres d'équipages militaires pourrait se justifier.

Le symposium a été réparti en trois sessions pour permettre l'examen des différents sujets se rapportant aux membres d'équipages vieillissants qui travaillent dans des environnements militaires stressants. Lors de la session sur «Les aspects opérationnels du vieillissement des équipages», des communications ont été présentées sur la tolérance aux accélérations, les effets du décalage horaire, les maladies de la moelle épinière, les résultats des électrocardiographies réalisées lors de séances d'entraînement en centrifugeuse, la tolérance à l'hypoxie, les durées de conscience utile en vol hypobare et sur la fonction pulmonaire chez les plongeurs. La session intitulée «Les membres d'équipages vieillissants: les conséquences pour les performances psychologiques et cognitives», a comporté des communications sur le sommeil, la mémoire auditive, la personnalité, le comportement, la fatigue, la prise de risques, la sécurité et l'achèvement de la mission, les performances psychologiques, les limites cognitives et sensorielles, et les renvois en neuropsychiatrie. Lors de la dernière session sur «Les aspects physiologiques et sensoriels du vieillissement», des communications ont été présentées sur l'immunisation contre l'anthrax, l'hormone de croissance, les réponses endocrines aux programmes d'entraînement, le contrôle cardio-vasculaire autonome, les indices biochimiques-métaboliques, le dysfonctionnement endothélial, l'épaisseur intima media, les facteurs de risque cardio-vasculaires, l'acuité visuelle, les problèmes oculaires, les lentilles intraoculaires, les performances visuelles lors de tests de contraste sur des lettres minuscules et le cockpit moderne.

A la différence de la plupart des études disponibles sur les effets du vieillissement sur les performances humaines, qui concernent les populations civiles, ce symposium a proposé des informations sur les effets du vieillissement sur les performances des membres d'équipages militaires, qui ne sont pas considérés normalement comme «des personnes âgées», qui vivent et qui travaillent dans des environnements opérationnels militaires stressants (environnements hypobares, hyperbares, accélérations élevées etc..) souvent pendant des périodes prolongées. Ces données ont une pertinence militaire particulière, eu égard à la progression de la moyenne d'âge des populations (y compris dans les populations militaires), à la croissance prévue des coûts d'entraînement, à la diminution des moyens financiers et du personnel que connaissent beaucoup de forces armées, et, par conséquent, à l'intérêt croissant de disposer de membres d'équipages vieillissants, expérimentés et en bonne santé.

Trois conclusions importantes ont pu être tirées des données présentées, à savoir: (1) A cette époque où l'accent est mis sur la prévention, la promotion de la santé et les habitudes de vie saine, l'âge physiologique d'un individu semblerait être plus important que l'âge chronologique d'un groupe. (2) Les connaissances, le comportement et l'expérience sembleraient largement compenser le vieillissement des membres d'équipages militaires. (3) Ce qui précède, combiné avec les nouvelles thérapies médicales et chirurgicales et les avancées technologiques (conception des équipements etc..) semble largement justifier le réexamen des politiques actuelles en matière d'âge des membres d'équipages militaires (en particulier si les prévisions en matière de budget et de personnels militaires d'un pays le rendent opportun).

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| 13. Keywords/Descriptors      | <table border="0"> <tr> <td>Aging (biology)</td> <td>Abilities</td> </tr> <tr> <td>Age</td> <td>Military operations</td> </tr> <tr> <td>Human factors engineering</td> <td>Stress (psychology)</td> </tr> <tr> <td>Flight crews</td> <td>Cognition</td> </tr> <tr> <td>Pilots (personnel)</td> <td>Stress (physiology)</td> </tr> <tr> <td>Divers</td> <td>Perception</td> </tr> <tr> <td>Performance evaluation</td> <td></td> </tr> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                      |                                        | Aging (biology) | Abilities | Age | Military operations | Human factors engineering | Stress (psychology) | Flight crews | Cognition | Pilots (personnel) | Stress (physiology) | Divers | Perception | Performance evaluation |  |
| Aging (biology)               | Abilities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                      |                                        |                 |           |     |                     |                           |                     |              |           |                    |                     |        |            |                        |  |
| Age                           | Military operations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                      |                                        |                 |           |     |                     |                           |                     |              |           |                    |                     |        |            |                        |  |
| Human factors engineering     | Stress (psychology)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                      |                                        |                 |           |     |                     |                           |                     |              |           |                    |                     |        |            |                        |  |
| Flight crews                  | Cognition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                      |                                        |                 |           |     |                     |                           |                     |              |           |                    |                     |        |            |                        |  |
| Pilots (personnel)            | Stress (physiology)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                      |                                        |                 |           |     |                     |                           |                     |              |           |                    |                     |        |            |                        |  |
| Divers                        | Perception                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                      |                                        |                 |           |     |                     |                           |                     |              |           |                    |                     |        |            |                        |  |
| Performance evaluation        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                      |                                        |                 |           |     |                     |                           |                     |              |           |                    |                     |        |            |                        |  |
| 14. Abstract                  | <p>In downsizing militaries with aging populations, the current and projected scarce resources, increasing costs of training and the significant experience (also at significant cost) of aging crewmembers makes aging crewmembers an increasingly valued commodity, particularly in militaries of the future. Experience, wisdom, healthy lifestyles and medical and technological advances seem to compensate to some extent for actual or presumed decreased performance and other adverse effects of aging (physical, physiological, psychological) in many crewmembers. Most "aging" studies and data, however, were on general (civilian) populations. Available data on the performance of aging crewmembers in stressful military environments have not been previously summarized and presented on any large scale. Military age policies (pilots, special crew, etc.) of several countries were collected in advance for presentation and discussion, and the NATO Human Factors and Medicine Symposium on "Operational Issues of Aging Crewmembers" was held in Toulon, France 11-14 October 1999. There were two keynote speaker presentations and 32 papers presented to the 120 participants registered for the symposium. The broad aspects of this topic were divided into three Sessions, including 12 papers on "Operational Aspects of Aging Crewmembers", 8 papers on "Aging Crewmembers: Psychological and Cognitive Performance Implications", and 12 papers on "Physiological and Sensory Aspects of Aging". Speakers presented data on a wide variety of effects on aging, including the effects of G forces, jet lag, spinal disease, ECG findings during centrifuge training, hypoxia tolerance and pulmonary function (in older divers), sleep, working memory, risk taking, cognitive and sensory limitations, personality and behavior, neuropsychiatric referrals, anthrax immunization, growth hormone, endocrine response to training, autonomic cardiovascular control, biochemical-metabolic indices, endothelial dysfunction, intima media thickness, cardiovascular risk factors, ocular problems and intra-ocular lenses, small letter contrast tests and modern cockpits. There was a notable lack of data on women crewmembers and this data needs to be obtained whenever possible during future studies of aging crewmembers. One could conclude from the data available so far that: (a) During these times of prevention, health promotion and healthy lifestyles, physiologic age of individuals seems to be more important than chronological age of groups; (b) Knowledge, behavior and experience seem to adequately compensate for aging crewmembers in military environments; and, (c) The above, combined with new medical and surgical therapies and technological advances (in equipment designs, etc.), appear to justify seriously re-looking at current age policies for military crewmembers (particularly if, and when, a country's military manpower and budget projections deem it appropriate).</p> |                      |                                        |                 |           |     |                     |                           |                     |              |           |                    |                     |        |            |                        |  |





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